

Dirk Hartog Island National Park ecological restoration project

Stage one final report

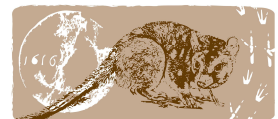
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February 2019



Department of **Biodiversity,
Conservation and Attractions**



DIRK HARTOG ISLAND
RETURN TO 1616

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Cover photograph: Releasing a banded hare-wallaby to Dirk Hartog Island, by Richard Manning.

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DBCA thanks Geoff Wardle, former lessee of Dirk Hartog Island (DHI), for commencing sheep and goat removal in expectation of DHI becoming a national park. We also thank the Wardle family and Jock Clough for allowing their private land on DHI to be included in the whole-of-island eradication programs.

Executive Summary

The Dirk Hartog Island (DHI) National Park ecological restoration project, entitled *Return to 1616*, aims to restore DHI National Park to an ecological state similar to what the Dutch navigator Dirk Hartog would have seen when he landed there in 1616. This endeavour represents the flagship project of the Gorgon Barrow Island Net Conservation Benefits Fund.

The first stage of the project has achieved significant milestones since commencement. In 2012, key project staff were appointed and management and steering committees established. In May 2014 the department received delivery of Wirruwana, a purpose-built high-speed landing craft to transport staff, vehicles and equipment necessary to service the project. In 2012 a draft biosecurity plan, fire management plan and weed management plan were prepared by consultants. A biosecurity implementation plan was prepared by the department in 2014 (revised 2015) with the assistance of the island owners/managers and biosecurity protocols continue to be implemented by the department, and their adoption encouraged by the community of Shark Bay and visitors.

Staff accommodation camps were established at Herald Bay and Sandy Point and construction of a cat barrier fence across the island was completed in 2014 to assist with feral cat eradication. A network of cat monitoring tracks and motion sensing cameras was installed for detection and monitoring of cat activity and the island was aurally baited for cats in 2014 and 2015. The last cat was detected on DHI in October 2016. To assist in confirming eradication, the department contracted the use of cat detector dogs, and conducted nine mid-season intensive cat monitoring programs across the remaining two years of the project. Feral cats were declared eradicated in October 2018, with an independent evaluation of the process and methodology used to undertake cat detection and eradication on DHI corroborated by Island Conservation in early 2019.

Eradication of sheep and goats from DHI commenced when the former lessee began destocking in 2007 in anticipation of the island becoming a national park. Ground shooting operations were conducted by the department in 2008 and 2009. After October 2009, when the national park was established, regular aerial shooting operations began. Sheep were eradicated by June 2016, and goats eradicated by November 2017.

As part of the biosecurity program, surveys for introduced black rats were conducted on DHI and in the adjacent towns of Denham, Useless Loop and Monkey Mia. No rats were detected either on DHI or on adjacent mainland areas. Other work undertaken has included vegetation monitoring using remote sensing, annual weed control/eradication work and monitoring of weed surveillance areas, monitoring surveys of three threatened bird species, monitoring of source mammal populations, pilot hare-wallaby translocation trial and implementation of community engagement and education programs.

Based on the success of stage one and the progress on the eradication of cats from DHI, on 9 October 2016, the then Minister for Environment approved funding for stage two of the project; allowing for the re-introduction of 10 species of native mammal and one species of bird, and the introduction of two other threatened mammal species for conservation reasons.

This final report, for the first stage of the DHI National Park ecological restoration project covers the period from February 2012 to February 2019.

1 Introduction

Dirk Hartog Island (DHI) is Western Australia's largest island with an area of over 63,300 hectares, and forms part of the Shark Bay World Heritage Property. DHI once supported at least 13 native terrestrial mammal species (Baynes 1990, McKenzie *et al.* 2000), of which only three persist following the introduction of cats, sheep and goats over the last 150 years. In the 1800s, the island was used as a base for whaling, guano collection and pearling, and since the 1860s it has been used as a pastoral lease. More recently it has been subject to increasing recreational use and in 2009, most of the island became a national park.

The DHI National Park ecological restoration project, entitled *Return to 1616*, offers a unique opportunity to restore the major ecological values of DHI to what they were when the Dutch navigator Dirk Hartog landed on the island in 1616; it is the largest ecological restoration project in the southern hemisphere. This would be achieved by first eradicating sheep, feral goats and feral cats from the island; confirming black rat absence; implementing quarantine protocols; and re-establishing healthy vegetation and ecosystem processes. This would allow for the second stage of re-establishing 10 species (Shark Bay bandicoot, dibbler, boodie, Shark Bay mouse, stick-nest rat, woylie, heath mouse, desert mouse, mulgara and chuditch) of mostly threatened mammals and one native bird species (western grasswren). Two additional mammal species (rufous and banded hare-wallabies), that may have previously inhabited the island, will also be introduced for conservation purposes. Once completed, the terrestrial mammal fauna will be increased to 15 species, the most diverse of any Western Australian island, further enhancing the values of the World Heritage Property (DEC 2012a). Many of the mammal species are now restricted to a few offshore islands, or mainland fenced conservation enclosures (Morris *et al.* 2017); with eight species listed as threatened under the WA *Wildlife Conservation Act 1950* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

A proposal for the DHI National Park ecological restoration project was submitted by the former Department of Environment and Conservation to the Gorgon Barrow Island Net Conservation Benefits (NCB) Advisory Board in late 2011, proposing a two-stage process for achieving this (DEC 2011). The Advisory Board subsequently endorsed the proposal and on 9 February 2012, the Minister for Environment approved NCB funding of \$8,545,162 over seven years (2011–12 to 2017–18) for the first stage.

The 2011 proposal included a statement that “A more detailed submission will be provided to the Board in November 2012 outlining budgets, timeframes and milestones for each of the project elements for 2012/13 to 2017/18. This will ensure that all activities and costs are fully accounted for and will avoid budget overruns or inability to deliver on project elements.” During the first year of the project the more detailed submission referred to in the project summary was developed and endorsed by the Advisory Board. On 5 February 2013, the Minister for Environment approved the revised funding submission and an additional \$2,991,947 of NCB funding over the remaining six years of the project.

This project is based on the objectives, and expanded elements and budget as approved in the revised funding submission (DEC 2012a) and as committed in the governance arrangements to the Advisory Board in the *Dirk Hartog Island National Park Ecological Restoration Project, Project Plan, May 2013* (DEC 2013a).

To meet reporting requirements, a half yearly update and an annual report detailing project performance is to be submitted to the Account Administrator, for prompt transmission to the Advisory Board, for each financial year of the project term. In addition, a final project report is to be made on completion of each stage of the project. This report fulfils the final reporting requirements for stage one of the project.

1.1 Goal and objectives

The goal for the project is to re-establish up to 10 terrestrial native mammal and one bird species on the island and establish up to two native mammal species that may have previously occurred there, along with healthy vegetation and ecosystem processes to sustain the island's biodiversity. With the objectives:

Ecological objectives

- 1 Eradicate sheep and goats.
- 2 Eradicate cats.
- 3 Confirm presence/absence of introduced black rats and eradicate/control these, if found.
- 4 Control high priority environmental weeds.
- 5 Implement effective quarantine protocols to prevent introduction/reintroduction of high priority exotic animals and weeds.
- 6 Rehabilitate identified high priority areas of degraded vegetation and disturbance.
- 7 Reintroduce 10 mammal and one bird species that are locally extinct on the island and introduce two mammal species that possibly occurred there in the past.

Community objectives

- 8 Increase community awareness of, and support for, the project and the island's biodiversity values.
- 9 Promote scientific research associated with the project and publish reports on the project as well as scientific findings.
- 10 Facilitate community involvement in island conservation as well as recreation and tourism use that is consistent with the project's objectives.

Stage one addressed ecological objectives 1 to 5 and community objectives 8 and 9. Stage two of the project will address ecological objectives 4, 5, and 7 and community objectives 8 to 10. Ecological objective 6 will not be completed due to funding constraints, unless further funding becomes available.

1.2 Element activities funded

The May 2013 project plan detailed the elements and activities that would be completed or substantially implemented in the first stage of the project. The elements implemented in the first stage of the project include: management and coordination; sheep and goat eradication; cat eradication; black rat surveys; biosecurity; vegetation restoration (monitoring); fire management; weed management; fauna reconstruction; community engagement; and reporting.

2 Implementation and outcomes

2.1 Management and coordination

Introduced animals have potential for serious impacts on natural systems and values through direct effects such as predation, habitat destruction, accelerated erosion, competition for food and territory and introduction of disease. DHI is known to support sheep, feral goats, feral cats and potentially black rats. The eradication of these species in stage one is crucial to the success of the fauna reconstruction program in stage two of the project. The project has been carefully planned and coordinated to ensure that the different elements of the project met their objectives and outcomes as outlined below to ensure the eradication of the introduced species at least two years before the full-scale fauna translocations.

When the project commenced in February 2012, a project manager, a project officer and a part-time officer were appointed; and a local Aboriginal trainee was employed in March 2015 under the department's Mentored Aboriginal Training and Employment Scheme. A steering committee and a management committee were also established to ensure the project was given the appropriate priority and support and meets project objectives, outcomes and outputs as detailed in the May 2013 project plan.

A detailed work plan was prepared identifying project works, milestones, budgets and outputs for each project element, consistent with the May 2013 project plan, and completed by 30 June in each year of the project term.

An environmental impact assessment (DEC 2013b) was prepared and approved by the department in March 2013, providing approval for vegetation clearing associated with the network of cat monitoring sand pads and connecting tracks, cat barrier fence, Herald Bay operations base, Sandy Point temporary field base, Herald Bay barge landing site and a track linking the proposed barge landing site to the Quoin Bluff track. To support the environmental impact assessment, the project commissioned the completion of a priority flora impact assessment (Atkins 2013), heritage assessment (Yamatji Marlpa Aboriginal Corporation 2013), erosion potential assessment (Oceanica Consulting 2013), stability assessment of the proposed barge landing site (Damara WA and Oceanica Consulting 2013) and a visual impact assessment (DEC 2013c).

A Heritage Agreement was negotiated with the Yamatji Marlpa Aboriginal Corporation in March 2013 to ensure that the proposed works did not impact upon Aboriginal Heritage values. A Heritage survey completed in April 2013 provided clearance for the proposed works at Herald Bay and Sandy Point (Yamatji Marlpa Aboriginal Corporation 2013), whilst site monitors were engaged in July 2014 prior to soil disturbance works associated with the cat fence construction. The Herald Bay operations base and the Sandy Point secondary field base were subsequently constructed in April 2014 and December 2015 respectively.

A priority flora survey as recommended in the DHI flora impact assessment was conducted in August 2013, prior to construction of the barrier fence and monitoring tracks. The report concluded that proposed mulching of the central location and clearing of the fence line will not have a significant impact on the priority flora species (Zhang 2013).

In May 2014, the department received delivery of Wirruwana, a purpose-built high-speed landing craft to transport staff, vehicles and equipment necessary to service the project. Three environmentally sensitive moorings were established at DHI for mooring Wirruwana in August 2014 and one in the Denham harbour in June 2013 and an engineer designed cyclone tie down point established in the Denham townsite.

2.2 Sheep and goat eradication

DHI had a history of pastoralism from the 1860s until 2009 when the island became a national park, except for several small freehold properties and reserves retained in the park. With the long history of sheep pastoralism and believed release of domestic goats following automation of the light house, the island was estimated to hold as many as 20,000 sheep (*Ovis aries*) and goats (*Capra hircus*).

Removal of sheep and goats from DHI commenced when the former lessee began destocking in 2005, through mustering and removing sheep and some goats from the island, and ground shooting goats with the assistance of the former Department of Environment and Conservation, in anticipation of the island becoming a national park. From 2010, a concerted effort to remove the remaining sheep and goats began through a regular and methodical aerial shooting program initially funded through a Caring for our Country grant from the Commonwealth Government, which ended in mid-2013, and then funded by the Gorgon Barrow Island Net Conservation Benefits Fund for the remainder of the program. The use of radio collared adult female 'Judas' goats was implemented to assist the aerial shooting program by locating the 'Judas' goats through radio telemetry during each aerial program and removing any associated un-collared goats. The aerial shooting program was conducted three times per annum and became the primary method of control and proved very effective by removing 6933 goats and 124 sheep from DHI.

To monitor the reduction in sheep and goat numbers and assist in determining when eradication was achieved, several monitoring methods were adopted. These included recording the reduction in the number of sheep and goats shot in consecutive aerial shooting programs; monitoring 'Judas' goat activity; monitoring sheep and goat activity on motion sensing cameras set at three water troughs; monitoring a network of 174 motion sensing cameras established across the island for the cat eradication program; and recording sheep and goat sightings and tracks and fresh scats during the cat monitoring program and other management activities.

By February 2013, 5185 sheep were removed from DHI through mustering and ground and aerial shooting. In June 2016, sheep were declared eradicated from DHI after no further sheep were detected following three years and four months or nine consecutive aerial programs after the last two sheep were shot. This declaration was subsequently supported by statistical analysis of the monitoring data which found that the estimated likelihood that sheep have been successfully eradicated from the island is 99.99 per cent.

The last un-collared goats were removed in November 2015 and the last 'Judas' goat in November 2017. At this time goats were declared eradicated as no un-collared goats had been detected following two years or six consecutive programs after the last un-collared goats were shot. This declaration was subsequently supported by statistical analysis of the

monitoring data which found that the estimated likelihood that goats have been successfully eradicated from the island is 96.9 per cent.

From 2005 to November 2017, 5185 sheep and 11,133 goats were removed from DHI through mustering and ground and aerial shooting, achieving a combined total of 16,318 sheep and goats removed. DHI is now the largest island in the world where sheep and goats have been successfully eradicated from a whole island (DIISE 2015). Vegetation monitoring by the project using satellite imagery has shown a significant increase in vegetation cover and reduction in the size and rate of spread of sand dunes following sheep and goat removal.

The following paper was published online in the journal *Biological Invasions*:

Heriot S, Asher J, Williams MR, and Moro D (2019). The eradication of ungulates (sheep and goats) from Dirk Hartog Island, Shark Bay World Heritage area, Australia. *Biological Invasions* <https://doi.org/10.1007/s10530-019-01937-7>.

2.3 Cat eradication

Feral cats became established on DHI during the late 18th century and were introduced in two main waves, the first introduction likely by early pastoralists around 1860 and then a more recent introduction which ceased some years ago (Koch *et al.* 2014). Feral cats are known to cause extinction of endemic species on islands, with small to medium-sized mammals particularly prone to predation. Feral cat eradication is considered critical to the success of the project and is required prior to the commencement of the fauna translocation program (DEC 2012a).

Preparation for feral cat eradication began in 2009, with a pilot study to ensure aerial baiting could work on the island. Sixteen feral cats were caught and fitted with satellite collars three weeks pre-baiting. Monitoring and retrieval of carcasses indicated that one cat died before baiting and twelve died after eating a poisoned bait. The 80 per cent success rate indicated that aerial baiting using *Eradicat*[®] baits as the primary eradication technique could be a highly effective eradication method on DHI (Johnston *et al.* 2010). Information obtained from the satellite radio collars during the pilot study revealed that the optimal spacing of camera traps and monitoring survey tracks be spaced approximately 2km apart to enable detection of adults within each survey period. An operation plan for the eradication of the feral cat population on DHI was prepared based on this preliminary work (Algar 2010).

To enable an effective eradication campaign the island was divided into two management units, with the construction of a 13km barrier fence across the island in 2014. To allow effective monitoring of the cat population a 2km grid network of 169 camera traps and connecting tracks was also established across the island. This necessitated the maintenance of 62km of existing secondary tracks and the construction of approximately 150km of new tracks to provide All Terrain Vehicle access to the camera traps. Additional cameras were installed at key locations such as the fence ends and access gates. Temporary accommodation and a field base were constructed at Herald Bay in 2014 and a secondary field base at Sandy Point in 2015.

The entire island was aerially baited in May 2014, which was followed by an intensive monitoring/trapping program in the southern management unit (200km²) to locate any remaining cat activity. Prior to the baiting campaign, 17 cats were trapped and fitted with radio-collars in the southern management unit. Fourteen of the 15 radio-collared cats that

were known to be alive pre-baiting died, suggesting a 93 per cent reduction in the feral cat population. The eradication campaign in the northern management unit (420km²) used a similar strategy, with aerial baiting undertaken in May 2015. The combined monitoring programs detected 36 individual cats following the baiting programs. The last sign of feral cat activity on DHI was during August 2015 in the southern management unit and during October 2016 in the northern management unit.

Following the completion of each intensive monitoring/trapping program a team of specialist detector dogs and their handlers (Latitude 42 Environmental Consultants Pty Ltd) were contracted to detect the presence and location of any remaining cats or to independently verify the absence of cats and corroborate that eradication has been successfully achieved. The detector dog team was deployed south of the barrier fence during June-August 2015. The team recommended that there was a low cat abundance south of the fence given that a scat was detected on 2 July 2015 (Holdsworth *et al.* 2015). A feral cat was subsequently photographed on a camera trap in August 2015 and removed in November 2015. It is likely that this cat was responsible for the scat found by the detector dog team. Redeployment of the detector dog team south of the fence in June 2016 verified that there was no further sign of fresh cat activity and provided confidence that feral cats were absent in the southern management unit (Holdsworth *et al.* 2016). Deployment of the detector dog team north of the barrier fence in July 2017 verified that there was no sign of fresh cat activity and provided confidence that cats were absent in the northern management unit (Holdsworth *et al.* 2017).

A two-year intensive seasonal surveillance monitoring program was carried out island-wide between October 2016 and September 2018, to ensure that no cats had been overlooked or reintroduced and to allow the confident declaration of cat eradication. These seasonal surveys, each which spanned a 20-day period, resulted in no sign of cat activity post the removal of the last known feral cat captured on 9 October 2016. Following 24 months of no feral cat detections, the consensus probability of feral cats persisting on DHI is calculated at 0.022 (modified consensus estimate of 0.001). As such, feral cats were declared eradicated in October 2018. Globally, the eradication of cats from DHI is the largest successful island cat eradication campaign attempted to date (DIISE 2018).

An independent review carried out by Island Conservation corroborated the eradication of feral cats from DHI. Overall, they found the eradication strategy, project implementation and surveillance monitoring to be well designed and executed with a high-level of confidence in achieving eradication success following two years of no detections (D Will, Island Conservation *pers. com.*).

The following manuscript is in the process of being published:

Algar D, Johnston M, Tiller C, Onus M, Fletcher J, Desmond G, Hamilton N and Speldewinde P (in review). Feral cat eradication on Dirk Hartog Island, Western Australia.

The following manuscripts, abstracts and scientific findings have been published or presented:

Algar D (2018) Cat eradication on Dirk Hartog Island. (Abstract) In: WA Feral Cat Symposium 31 May 2018, Mandurah.

Algar D, Hilmer S, Onus M, Hamilton N and Moore J (2011). New National Park to be cat-free. *Landscape* **26**(3), 39–45.

Algar D and Johnston M (2015) Eradication of feral cats from Western Australian islands: success stories. In: National Feral Cat Workshop Proceedings (eds. J Tracey, C Lane, P Fleming, C Dickman, J Quinn, T Buckmaster and S McMahon). PestSmart Toolkit publication, Invasive Animals Cooperative Research Centre, Canberra, Australia. Canberra 21–22 April 2015, 112–116.

Algar D and Johnston M (2015). Eradication of feral cats from Western Australian islands: an update. In: Proceedings of the 2015 Australian Wildlife Management Conference, 23– 26 November 2015, Mercure Hotel, Perth, Western Australia.

Algar D, Johnston M and Hilmer SS (2011). A pilot study for the proposed eradication of feral cats on Dirk Hartog Island, Western Australia. In: Island Invasives: Eradication and Management (eds. CR Veitch, MN Clout and DR Towns) pp 10–16. IUCN, Gland, Switzerland.

Algar D, Johnston M, O'Donoghue M and Quinn J (2015). What is in the pipeline? Eradicat[®], Curiosity[®], and other tools. In: National Feral Cat Workshop Proceedings (eds. J Tracey, C Lane, P Fleming, C Dickman, J Quinn, T Buckmaster and S McMahon). PestSmart Toolkit publication, Invasive Animals Cooperative Research Centre, Canberra, Australia. Canberra 21–22 April 2015, 78–84.

Algar D, Johnston M, O'Donoghue M and Quinn J (2016). An update of feral cat control in Western Australia. (Abstract) In: Australian Mammal Society Conference, Alice Springs 26– 29 September 2016.

Algar D, Johnston M and Pink C (2017). Big island feral cat eradication campaigns: an update (Abstract) In: Island Invasives 2017, July 2017, Dundee Scotland.

Algar D, Johnston M and Pink C (2019). Big island feral cat eradication campaigns: an overview and status update of two significant examples. In: Island Invasives: Scaling up to meet the challenge (eds. CR Veitch, MN Clout, AR Martin, JC Russell and CJ West) pp 238-243. Occasional Paper SSC no. 62. IUCN, Gland, Switzerland.

Algar D, Johnston M, Tiller C, Fletcher J, Onus M, Desmond G, Hamilton N and Speldewinde P (accepted 2018). Feral cat eradication on Dirk Hartog Island, Western Australia. (Abstract) In: Island Arks Symposium VI – Rottneest Island, Western Australia, February 2019.

Algar D and Mitchell S (2013). Controlling cats: the work continues. *Landscape* **28**(3), 52–58.

Bengsen AJ, Algar D, Ballard G, Buckmaster T, Comer S, Fleming PJS, Friend AJ, Johnston M, McGregor H, Moseby, K and Zweke F (2016). Feral cat home range size varies predictably with landscape productivity and population density. *Journal of Zoology* **298**, 112–120.

Bode M, Brennan KEC, Helmstedt K, Desmond A, Smia R and Algar D (2013). Interior fences reduce cost and uncertainty when eradicating invasive species from islands. *Methods in Ecology and Evolution* **4**(9), 819–827.

Campbell KJ, Harper G, Algar D, Hanson CC, Keitt BS and Robinson S (2011). Review of feral cat eradications on islands. In: Island Invasives: Eradication and Management (eds. SR Veitch, MN Clout and DR Towns) pp 37–46. IUCN, Gland, Switzerland.

Deller M (2013). The role of marine species in the diet of the feral cat, *Felis catus*, on Dirk Hartog Island: a dietary analysis. Bachelor of Science (Conservation Biology and Management) SCIE4501-4 FNAS Research Thesis Faculty of Science. The University of Western Australia.

Deller M, Mills HR, Hamilton N and Algar D (2015). Diet of feral cats, *Felis catus*, on Dirk Hartog Island. *Journal of the Royal Society of Western Australia* **98**, 37–43.

Johnston M, Algar D, O'Donoghue M and Morris J (2011). Field efficacy of the Curiosity feral cat bait on three Australian islands. In: *Island Invasives: Eradication and Management* (eds. CR Veitch, MN Clout and DR Towns) pp182–187. IUCN, Gland, Switzerland.

Johnston M, Algar D, Onus M, Desmond G, Tiller C, Fletcher J and Hamilton N (in press). Declaration on Dirk: feral cats eradicated. *Landscape*.

Johnston M, Holdsworth M, Robinson S and Algar D (2016/17). Noses on legs: detector dogs helping with feral cat control. *Landscape* **32**(2), 42–47.

Koch K, Algar D and Schwenk K (2014). Dispersal, population structure and management implications for invasive cats on Australian islands. *Journal of Wildlife Management* **78**(6), 968–975.

Koch K, Algar D and Schwenk K (2016). Feral cat globetrotters: genetic traces of historical human-mediated dispersal. *Ecology and Evolution*. Doi: 10.1002/ece3.2261.

Koch K, Algar D, Searle JB, Pfenninger M and Schwenk K (2015). A voyage to Terra Australis: human-mediated dispersal of cats. *BMC Evolutionary Biology*, 15,262 DOI 10.1186/s12862-05-0542-7.

2.4 Black rat surveys

Black rats (*Rattus rattus*) are regarded as a major threat to island biodiversity and a key cause of extinction, local population loss and decline of many native species. Exotic rodents are listed as a key threatening process under the *Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2009).

There have been plenty of opportunities for black rats to invade DHI as a result of the long European maritime and settlement history that is consistent with the invasion and establishment of black rats on many of Australia's other islands (Palmer 2017). In addition, there were two historical anecdotal records of black rats on DHI (DEC 2012a). Due to the high conservation value of the island and the negative impact of exotic rats it was considered essential to undertake surveys to ensure that DHI is free of black rats before fauna translocations occur.

Three targeted surveys for black rats were conducted on DHI. The first, in August 2011 focused on areas and buildings associated with human habitation and follow-up surveys in May 2013 and March 2016 had an island-wide focus. The latter surveys targeted areas with human habitation (inhabited or abandoned), richer coastal ecosystems on the sheltered eastern side of the island, artificial water points and the barge landing site at Cape Ransonnet. In addition, the surveys were extended to the neighbouring townsites on the mainland in May 2014, including Denham, Monkey Mia and Useless Loop, to determine if there was any

evidence of previous or current populations of black rats that could easily be transported to DHI.

The targeted surveys on DHI used a combination of rodent detection techniques. Baited (peanut butter and rolled oats) camera traps set at 20 sites in 2013 and 29 sites in 2016, for a combined effort of 2625 camera trap nights were the primary technique. In addition, roughly 200 pellets from rodent eating raptors, mostly the barn owl, were collected and analysed for rodent remains. Importantly, 2016 provided ideal conditions for monitoring rodents as high rainfall in 2015 coupled with reduced competition from sheep and goats, and limited predation by feral cats triggered rodent plagues amongst resident populations (sandy inland mouse *Pseudomys hermannsburgensis*, ash-grey mouse *P. albocinereus* and house mouse *Mus musculus*). Under these circumstances black rats would have been easily detected if they were present, by the target surveys or on the 169 camera traps that were set up in grid formation across the island to detect feral cats at the time.

The black rat survey on the adjacent mainland in May 2014 (Denham, Monkey Mia and Useless Loop) used a range of surveillance and detection techniques including 19 baited camera traps and 42 baited tracking tunnels set over a period of 1083 trap days, analysis of 199 predator pellets and scats and consultation with the local community and pest control businesses operating in Geraldton and Kalbarri.

No black rats or their remains were detected on DHI, or in the broader Shark Bay area. It is possible that they may have been resident in Denham in the 1960s or occasionally transported into Shark Bay from rat infested areas elsewhere, but they have not established breeding populations that have persisted (Palmer and Morris 2014). The final black rat report (Palmer 2017) recommended that there was no further requirement to undertake targeted surveys and that continued general surveillance and enforcement of island quarantine measures will ensure that DHI remains free of black rats.

2.5 Biosecurity

Integral to the success of the project is the support for and implementation of biosecurity protocols to prevent the introduction/reintroduction and establishment of high-risk pest species. Prevention of the arrival of pest species and diseases is the most cost-effective way to conserve the values of DHI (Astron Environmental Services 2012a).

A biosecurity plan was prepared by Astron Management Services with consultation from partner landholders in August 2012 to guide the management of biosecurity on DHI. Interim quarantine protocols were prepared in April 2013 for implementation by project staff, contractors and volunteers during the period when materials and equipment were being delivered to DHI; they were later used as a working example for discussion with other island stakeholders. In 2014, the then Department of Parks and Wildlife with assistance of the other island land owners and managers prepared a biosecurity implementation plan with quarantine protocols, which was later revised in 2015 (Asher and Morris 2015). The biosecurity implementation plan provided protocols and guidelines for the inspection and cleaning of vehicles, vessels, equipment and machinery to prevent the accidental introduction of weeds, pests and wildlife diseases. The department committed to the implementation of the quarantine protocols, with their adoption encouraged by the other island landowners and managers, Shark Bay community and DHI visitors.

To ensure community support for and adoption of biosecurity protocols, the department implemented an intensive visitor education campaign, which will be continued through stage two of the project. This included providing biosecurity educational material and advice in an island protection brochure, interpretive signage on the mainland and island, articles in the local Inscription Post and other print media, creation of a dedicated biosecurity page on the sharkbay.org website and promotion at local celebration events.

The biosecurity implementation plan and quarantine protocols will continue to be implemented in stage two of the project to prevent the introduction/reintroduction of high priority exotic animals and weed species.

2.6 Vegetation restoration

Following 150 years of grazing and trampling by sheep and feral goats, the islands vegetation had been heavily impacted and became degraded in many parts. A monitoring program was developed integrating Landsat time series data, repeated site and nadir photography and floristic surveys to provide a comprehensive picture of how the island's ecology has changed following destocking of introduced herbivores.

Changes were first detected and measured using Landsat satellite imagery captured between 1988 and 2018. This enabled calculation of changes in vegetation cover to be detected consistently over large spatial extents over time. The changes were then validated on-ground, by recording species diversity and cover at 33 monitoring sites to determine whether the increased cover corresponds to an improvement in condition.

Changes in the extent of sand dunes were analysed using historical aerial photography, captured 1957 and 1969, and Landsat satellite imagery captured between 1988 to 2018 to determine if the dunes would naturally recover following the removal of sheep and goats.

With the removal of sheep and goats, vegetation monitoring has shown that to 2018, 35 per cent of DHI has experienced a significant increase in vegetation cover since destocking using the baseline period 1988-2008 (van Dongen *et al.* 2018). Many of the areas shown by satellite imagery to have increased vegetation cover were found to be native species; furthermore, it appears that native species are out competing the introduced buffel grass. Analysis of the sand dune extent has shown a steady increase in dune coverage from 1957 to 2009, then a dramatic decrease between 2009 and 2018 (van Dongen *et al.* 2018). Vegetation monitoring will continue to be implemented in stage two of the project to confirm that the island's vegetation is continuing to improve or to determine if rehabilitation actions are required.

The remote sensing data was further used to assist with the selection of favourable habitat where vegetation recovery had been highest for the release of hare-wallabies in the pilot hare-wallaby translocation trial (Cowen *et al.* 2018). Additionally, further assistance was provided to the fauna translocation program in stage two to select appropriate representative locations for exclusion plots, using Sentinel satellite imagery and field validation, which would be used to measure the impact that translocated digging mammals would have on ecosystem processes, particularly seedling recruitment.

The following manuscript was submitted to the journal Ecological Management and Restoration:

Van Dongen R, Huntley B and Keighery G (submitted). Monitoring vegetation cover using high frequency Landsat imagery on Dirk Hartog Island.

2.7 Fire Management

There is a lack of detailed fire history information available for DHI. Given it is an island, has low visitation and is influenced by salt-laden air, ignition sources are limited and thus bushfires would be an infrequent event. No accounts of bushfires have been provided to the department, however, analysis of satellite images has indicated at least one fire occurred in the vicinity of Sandy Point during 1987.

A fire management plan for the DHI National Park was prepared by Strategen Environmental Consultants in August 2012, to consider the perceived increase in bushfire risk resulting from the anticipated increase in vegetative cover and density post the removal of introduced herbivores from DHI and the potential addition of high value environmental assets. The plan was commissioned by the department and developed in consultation with the land owners/managers on the island to provide guidance on how to plan and manage the potential wildfire risk and enhance the ecological values through the use of prescribed fire. The fire management plan concluded that the fire risk on DHI is low and recommended that fire management measures focus on the protection of important biodiversity assets, particularly the proposed release and establishment sites for the fauna species that are to be established on the island (Strategen 2012).

The key fire management recommendations for DHI National Park included vegetation monitoring, research into prescribed burning and creation of low fuel buffers, fire break construction, provision of a light fire unit on the island, and preparation of a pamphlet informing visitors on fire prevention and actions in case of fire (Strategen 2012).

With vegetation monitoring from satellite imagery showing a 28 per cent increase in vegetation cover (to 2015) following the removal of sheep and the significant reduction in goat numbers, the then Department of Parks and Wildlife's Fire Management Services Branch was commissioned to review the recommendations of Strategen's fire management plan. The 2015 review found that bushfire risk is not sufficiently high to require large investment in either prevention or suppression capability. However, moderate investment is required to mitigate human caused ignitions and provide reasonable opportunities to limit the spread of bushfire should it occur. The key fire management recommendations included bushfire risk mitigation around departmental infrastructure, preparation of visitor information concerning bushfire risk and bushfire safety, compartmentalisation of the island into at least three blocks utilising existing tracks wherever possible, conducting experimental fire behaviour research to determine if prescribed fire could create and maintain habitat opportunities, and vegetation monitoring (Armstrong 2015).

Fire management recommendations implemented during the first stage of the project included the provision of a slip-on fire unit, inclusion of visitor information concerning bushfire prevention and safety actions on interpretive signage and commencement of vegetation monitoring using remote sensing; with research into prescribed burning and other fire management measures as outlined in the fire management plan proposed during the second stage of the project.

2.8 Weed Management

DHI has experienced significant changes which have upset the natural ecosystem, facilitating the establishment and spread of weed species. Weeds pose a major threat to the natural environment through displacement particularly on disturbed sites, resulting in changes to the species composition, biomass distribution, hydrological patterns, nutrient conditions, soil erosion, and fire hazard (DEC 2012b). Consequently, managing weeds is an integral part of the project.

A baseline weed survey for DHI completed by Astron Environmental Services in 2012, focused on accessible tracks and designated infrastructure areas across the island (Astron 2012b). Astron Environmental Services then prepared the *DHI National Park Weed Management and Action Plan (2013-2018)* (Astron 2012c) during November 2012, which listed 49 weed species for DHI. These 49 species were assessed by Astron according to the department's invasive plant prioritisation process (IPPP) to identify the highest priority species for management. Eight priority weed species were identified with a weed management plan prepared for each; five species were designated for eradication and three species for control. In total 17 weed management areas (WMAs) were identified across DHI National Park. The plan also provided an 'alert weed list' and identified 23 weed surveillance areas (WSAs) that were deemed to be at high risk for introducing weeds to the island.

WMAs were monitored annually between 2014 and 2017, with control implemented as required. The weed management program is progressing well, with most of the objectives for the eradicate species on target to be met.

Eradication of the only Japanese pepper (*Schinus terebinthifolia*) tree known in the national park is planned to coincide with the demolition of the old cook house, which it is growing alongside. Invasiveness is low as a male and female tree is required to enable reproduction.

All known castor oil (*Ricinus communis*) plants have been removed within two years, with all populations being checked annually for new seedlings. Eradication cannot be confirmed until 2027 as seed can remain viable in the soil for up to 10 years.

One WMA is on target for couch (*Cynodon dactylon*) removal in five years (2019) whilst the other couch WMA is being contained as it surrounds the homestead water supply well and is unable to be chemically treated, and mechanical control is unfeasible. Seed can remain viable for up to four years in the soil delaying eradication until four years after the infestation is removed.

Wild radish (*Raphanus raphanistrum*) is on target for eradication with no seedlings noted since August 2014. Eradication cannot be confirmed until 2034 as seed can remain viable in the soil for up to 20 years.

Lupin (*Lupinus cosentinii*) is on target for eradication with all plants removed prior to seed set since August 2017. Eradication cannot be confirmed until 2037 as seed can remain viable in the soil for up to 20 years.

Ruby dock (*Rumex vesicarius*) is on target for eradication with no seedlings noted since September 2015. Eradication cannot be confirmed until 2035 as seed can remain viable in the soil for up to 20 years.

WSAs were inspected annually between 2015 and 2017, with only one 'new to island' weed species, ruby dock, being identified during 2015 from an opportunistic survey. The population consisted of one plant that was hand removed prior to seed set. The systematic and opportunistic weed surveillance program will continue to be implemented during stage two to prevent the establishment of 'new to island' weed species.

The following report was produced:

DBCA (2017). Dirk Hartog Island National Park ecological restoration project weed management 1 July 2014 to 31 December 2017. Unpublished report, Department of Biodiversity, Conservation and Attractions, Perth, WA.

2.9 Fauna Reconstruction

Project savings identified in February 2013 were reallocated to fund the part B activity element 'Undertake monitoring of extant threatened fauna (one reptile and three bird species) on DHI' from July 2013 to June 2018, to determine their distribution and to develop a monitoring framework to assess population trends following the removal of cats and other threats from the island.

The western spiny-tailed skink (*Egernia stokesii badia*), which is endemic to DHI, is listed as threatened under the *WA Wildlife Conservation Act 1950* and Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. Three targeted surveys for the western spiny-tailed skink were conducted with one on the adjacent Peron Peninsula in April 2014 and two on DHI in April 2015 and May 2016. Despite extensive searching only one animal was located on the Peron Peninsula and seven on DHI. The final threatened reptile monitoring report recommended that monitoring of the western spiny-tailed skink be concluded due to difficulties in surveying, detecting and monitoring this cryptic species, combined with the lack of distinct threats on DHI (Pearson 2016).

Three threatened bird subspecies, as listed under the *WA Wildlife Conservation Act 1950*, are endemic to DHI including the DHI rufous fieldwren (*Calamanthus campestris hartogi*), DHI emu-wren (*Stipiturus malachurus hartogi*) and the DHI black and white fairy-wren (*Malurus leucopterus leucopterus*). In addition, the western grasswren (*Amytornis textilis*) which is common on parts of the Peron Peninsula and adjacent Hamelin station, is now believed to be locally extinct on the island. Opportunistic survey for the threatened bird subspecies occurrence commenced in May 2013, with targeted surveys implemented in October 2013 and September 2014, and abundance data gathered in August 2015 and September 2016.

Modelling of distance-sampling data collected in 2015 and 2016 demonstrated that the fieldwren is common and widespread on the island with preliminary population estimates between 12,000-20,000, the fairy wren is moderately widely distributed with preliminary population estimates between 15,000-24,000 and the emu-wren is moderately widely distributed with a preliminary population estimates between 17,000-37,000 (Burbidge *et al.* 2018a).

The final report recommended that given current personnel availability it would not be practical to continue distance sampling for future monitoring; however, the threatened subspecies should be monitored in more detail using distance sampling at five-year intervals to ensure management decisions can be made and evaluated with confidence (Burbidge *et al.* 2018a).

In addition, an identification guide for the six wrens on DHI was produced in May 2014, to increase awareness and assist in identification of the three threatened and one locally extinct species.

Genetic analysis and a morphological review were undertaken during 2014 to 2018 to facilitate resolution of the taxonomic uncertainty surrounding the DHI subspecies of the fieldwren (*C. campestris hartogi*). Results revealed that all Western Australian populations are part of the same species, *C. campestris*, without any subspecies being recognisable. Furthermore, *C. c. hartogi* and *C. c. dorrie* (Dorre Island rufous fieldwren) are both recommended for removal from threatened species lists, and that the DHI population be considered a Management Unit for conservation purposes (Burbidge *et al.* 2018b).

Monitoring of source mammal populations during the last two years of the first stage of the project was considered essential for enabling fauna translocations to proceed immediately in stage two of the project (DEC 2012a). Although not initially funded, the part B monitoring of source populations activity was achieved over 2015-16 to 2016-17, and 2017-18 using stage one project savings and NCB stage two (year 1) funding.

During 2015, the mammal abundance monitoring data collected on Bernier and Dorre islands, by various projects, between 2006 and 2013 was collated and analysed. Bernier and Dorre islands will most likely be the source(s) of some of the founder animals to be translocated to DHI including the banded (*Lagostrophus fasciatus*) and rufous (*Lagorchestes hirsutus*) hare-wallabies, Shark Bay bandicoot (*Perameles bougainville*), boodie (*Bettongia lesueur*) and the Shark Bay mouse (*Pseudomys fieldi*). Results suggested that total annual rainfall two years prior to the survey period was a strong driver of estimated population sizes on Bernier and Dorre Islands, with some influence from variations in monthly rainfall. The ideal time to remove founder animals would be approximately two years after above average rainfall (in excess of 300mm) at the Carnarvon airport (assuming this data is an accurate surrogate for actual rainfall on Bernier and Dorre islands), or after 6-12 months of below average monthly rainfall following this, when populations would be expected to be on the cusp of decline (Chapman *et al.* 2015). As part of improved monitoring, a satellite linked weather station recording rainfall was placed on Dorre Island in September 2015. Monitoring of potential source populations on Bernier and Dorre islands was carried out in August 2016 and on North West and Trimouille islands in October 2016. Combined abundance estimates for banded hare-wallaby, rufous hare-wallaby, Shark Bay bandicoot and boodies on Bernier and Dorre Islands were calculated at 5271, 3202, 1676, and 2899 respectively (Sims *et al.* 2018). Abundance of Shark Bay mouse on Northwest Island and rufous hare-wallabies on Trimouille Island were estimated at 2014 (unpublished data) and 838 (Sims *et al.* 2018) respectively.

Prior to the large-scale translocations planned for implementation in stage two, it was considered important to conduct a pilot hare-wallaby translocation trial south of the cat fence, conditional on the continued absence of feral cats south of the cat fence and reasonable confidence that cats had been eradicated north of the cat fence. With the confidence of cat eradication, the translocation trial was approved to commence in Spring 2017. The trial translocation provided the opportunity to test founder capture and holding techniques, transport logistics, release and monitoring procedures, and suitability of habitat (Parks and Wildlife 2016).

Pre-capture monitoring of banded and rufous hare-wallaby source populations on Bernier and Dorre islands during early August 2017 provided combined estimates of 6715 banded and 3415 rufous hare-wallabies (Sims *et al.* 2018). The hare-wallaby source populations were determined to be sufficiently abundant to permit harvesting and twelve (four male, eight female) banded hare-wallabies and 12 (four male, eight female) rufous hare-wallabies were captured, processed, transported and released on the southern part of DHI over 29 and 30 August 2017. Post-translocation survivorship was determined by a three-month period of intensive ground and aerial monitoring, and then less intensive aerial monitoring for four months, with the radio collars removed in April 2018 (Cowen *et al.* 2018).

Except for one rufous hare-wallaby that most probably died from capture myopathy, all other hare-wallabies were known to be alive and healthy up to the time their radio collars were removed. Additionally, six banded and 10 rufous hare-wallabies had pouch young or young at heel that were not present at translocation (Cowen *et al.* 2018).

The translocation trial was successful with all the short-term and three out of four medium-term translocation success criteria being met within the first nine months following release. The pilot translocation trial provided the confidence that translocations with larger founder numbers during stage two would also be successful (Cowen *et al.* 2018).

The following reports and scientific findings have been prepared or presented:

Ball J, van Dongen R, Huntley B and Burbidge AH (2015). Modelling the distribution of threatened wren species on Dirk Hartog Island. Unpublished report, Department of Parks and Wildlife and Curtin University, Perth, WA.

Burbidge AH (2015). Recent developments in the conservation of threatened birds in southern Western Australia. Presentation to BirdLife WA, as guest speaker at AGM, 23 February 2015.

Burbidge AH, van Dongen R, Ball J and Ford S (2015). Monitoring and modelling the distribution of rare birds on Dirk Hartog Island: how threatened are they? (Abstract) In Australasian Ornithological Conference, p 69. (BirdLife Australia and Birds New Zealand: Adelaide, South Australia).

Cowen S, Sims C, Garretson S, Rayner K, Angus J and Morris K (2018). Returning to 1616: The ecological restoration of the largest island in Western Australia (Abstract) In International Wildlife Reintroduction Conference (IUCN Reintroduction Specialist Group: Chicago, Illinois, USA) (reintro.org/abstracts/ Accessed 02/01/2018).

Dolman G and Burbidge AH (2015). Using phylogenetics of fieldwrens and heathwrens to inform conservation management in Western Australia (Abstract) In Australasian Ornithological Conference, p 56. (BirdLife Australia and Birds New Zealand: Adelaide, South Australia).

Karla Graham (2017/18). Returning wallabies to Dirk Hartog Island. *Landscape* **33**(2), 6.

Morris K, Page M, Thomas N and Ottewell K (2017). A strategic framework for the reconstruction and conservation of the vertebrate fauna on Dirk Hartog Island 2017-2030. Department of Parks and Wildlife, Perth, WA.

Rayner K, Cowen S, Sims C, Garretson S, Angus J and Morris K (2018). Welcoming wallabies to Wirruwana. *Landscape* **33**(4), 28-34.

2.10 Community Engagement

Important to the continued success of the project is support from the local community, stakeholders and visitors to the island, particularly in relation to biosecurity. An ongoing campaign to raise awareness of, and support for, the project and island biosecurity measures was therefore considered necessary. Implementation of the community engagement program was realised when the then Minister for Environment approved additional funding for 2012-13 to 2014-15 as proposed in the revised funding submission; with project savings extending funding through to 2017-18.

A community engagement strategy, consistent with the May 2013 project plan, was finalised in December 2013 and later revised in June 2015 (Pedersen 2015). The strategy identifies stakeholders, goals for communicating various elements of the project, possible tools for community engagement and the different levels of engagement. The strategy will continue to be regularly reviewed and adapted over stage two, to reach stakeholders and the community and reflect changes in the project.

The first media statement released by the then Minister for Environment in February 2012 announced the successful funding of the project under the Gorgon Barrow Island Net Conservation Benefits Fund. Further ministerial statements providing updates on project implementation were released in December 2012, October 2016, September 2017, and October 2018.

Regular articles published in the local Shark Bay newsletter 'Inscription Post' between January 2013 and November 2018 provided updates to the local community. Wider exposure of the project was provided through printed newspaper and scientific magazine articles, online articles, social media posts, radio interviews and a story aired on the BBC Breakfast and ABC News Sunday between December 2012 and October 2018.

The first issue of 'Shark Bay Watch', a local newsletter providing initial project information, was produced in May 2013 and distributed around Denham and Monkey Mia and sent electronically to DHI stakeholders. This was later replaced with annual project update flyers and more recently in Summer 2018 by the biannual newsletter 'Wirruwana News'.

A webpage dedicated to the project was created on the Shark Bay World Heritage website sharkbay.org during April 2013. This was regularly reviewed and updated to reflect changes in the project and to announce the completion of key milestones.

In 2013, interpretive displays were created for the inaugural community engagement event and continued to be displayed in the Shark Bay district office foyer until they were relocated to Monkey Mia in 2016 as an interim display. Additionally, a *Return to 1616* children's activity was developed for presentation at the community events and as an activity in the Monkey Mia school holiday program. In 2016, magnets illustrating each of the animals to be translocated under stage two of the project were created. These magnets were used during the *Return to 1616* children's activity as well as distributed during community engagement events. The *Return to 1616* children's activity was updated in 2018 to reflect the change in the project's progression from feral animal eradication to fauna translocations. Selfie frames featuring the *Return to 1616* animals and logo were created in 2018 with the aim of infiltrating social media.

Since 2013, annual community engagement events have taken different forms to reach as much of the Shark bay community as possible. The inaugural community celebration event

'What's happening on DHI' was held in July 2013 over two sessions. It attracted approximately 130 people and was considered successful in achieving the objective of fostering awareness and support for the project. This was followed by equally successful community celebration events on the Denham foreshore/project barge in partnership with the Yadgalah Aboriginal Corporation in 2014 and in partnership with Yadgalah Aboriginal Corporation and Bush Heritage in 2015; at Hamelin station as part of the Bush Heritage Science Fair in 2016, 2017 and 2018; and at the Denham district office in 2018.

Project and biosecurity information was included on signs at the Denham boat ramp in 2014; and at the Shark Bay airport, Useless Loop Road turnoff, and at Charlie Sappie Park (Denham) in 2015. Furthermore, the DHI National Park and Shark Bay World Heritage brochures were updated to include project information, and a new brochure informing of biosecurity issues was created.

A photo book detailing achievements and objectives for the first stage of the project was produced and distributed in 2015 to the DHI Lodge, department's Denham office, Bush Heritage Hamelin Station Stay, Steep Point rangers, Shire of Shark Bay office, Shark Bay Community Resource Centre, Discovery Centre and Monkey Mia. A second photo book which provided information on the second stage of the project was produced and distributed in August 2017.

As part of the Dirk Hartog 400-year celebrations, assistance was given to the Science Teachers' Association of Western Australia with the development of the *Return to 1616* educational resource package. The educational resource document was made available to teachers from the Associations website in February 2016.

To participate in the 400-year celebrations, the project in partnership with the Shark Bay Arts Council engaged an artist-in-residence to run weaving workshops with a *Return to 1616* theme for the Shark Bay community and for the Shark Bay School in August 2016. The students' artwork was exhibited at the World Heritage Discovery Centre during the DHI festival in October 2016 and the four large animals produced as part of the weaving workshop were permanently installed at the front of the department's office in Denham. The artworks received a lot of attention throughout the 400-year celebrations since Dirk Hartog's landing and continue to attract visitors.

In 2017, the Project partnered with the Shark Bay Arts Council to hold a 'Celebrating the nature of Shark Bay' art exhibition in Denham and Monkey Mia. In total 53 pieces of artwork were submitted and displayed over August to September 2017. The *Return to 1616* section of the exhibition, 13 paintings depicting the translocation species, is on permanent loan to the Shark Bay Community Resource Centre.

Biosecurity interpretive signs were developed in 2018 for Edel Land (Steep Point) to encourage visitors to check their vehicles and equipment for 'hitchhikers' before boarding the barge, and an orientation and project information sign was developed for DHI.

Community engagement will continue into stage two to encourage and assist the community and island stakeholders to understand and appreciate the values of the island and the project, and to actively support the project to ensure its continued success.

2.11 Reporting

Quarterly updates and an annual report were prepared and submitted to the Advisory Board, consistent with the May 2013 project plan, for each year of the project term between July 2012 and June 2015. The Account Administrator advised, in correspondence dated 25 September 2015, that he supported the Advisory Board's advice that the project's progress reporting be adjusted to be consistent with the six-monthly funding instalments, with the provision of a half yearly update and an annual report for the remainder of the first stage of the project. A half year update and an annual report were prepared and submitted to the Advisory Board for the remainder of the project term between December 2015 and December 2018.

The updates and annual reports outlined milestone performance, financial expenditure and output delivery during that reporting period. They also included information on any significant occurrence which might adversely affect the department's ability to complete the project in accordance with the May 2013 project plan.

3 Financial statement

A summary of the project's financial performance for stage one is provided in Table 1 and Table 2. Appendix 1 details the project savings identified during the financial year and reallocated to meet additional budget requirements or to fund new activities.

3.1 NCB expenditure

The project expended \$11,075,467 NCB funds from the \$11,537,109 allocated to the first stage of the project; in addition, \$348,508 budget was carried into stage two to partially fund the construction of the airstrip near Herald Bay over winter 2019. The remaining \$113,134 budget surplus will be carried into stage two as project contingency.

3.2 In-kind expenditure

The department contributed \$3,620,329 in-kind funds to the project during stage one against a budget of \$5,227,643. This included \$1,511,603 for assistance with overall project works, ranger patrols and visitor management, fauna monitoring, island clean-up activities, logistical support for the goat program, improving island infrastructure, and \$100,000 contribution to the barge purchase; \$1,638,385 for implementation of the cat eradication, black rat and fauna reconstruction programs; and \$370,341 from the Caring for our Country project for the aerial goat shooting/monitoring program.

The in-kind variance of \$1,607,314 primarily relates to Government budget adjustments that impeded the construction of the operations base (DEC 2012a) (\$1,132,000) and expenditure that could not occur as the project started later than anticipated (\$312,969).

3.3 Interest accrued in the Operating Account

Interest of \$326,846.33 was accrued in the Operating Account during the first stage of the project. This interest was used to fund the 2017 hare-wallaby pilot translocation trial, south of the cat fence, as advised to the Advisory Board in the 2015-16 annual report (Parks and

Wildlife 2016). The trial was successfully achieved with expenditure of \$325,460 processed directly against the Operating Account during 2016-17 to 2017-18, leaving \$1,386.33 interest which will be available to use in stage two of the project.

Table 1 Summary of project expenditure, stage one

Item	Budget	YTD actual expenditure	Variance	Percentage variance
Overall project funding (NCB)	\$11,537,109	\$11,075,467.47	\$461,641.53	4%
Overall project funding (in-kind)	\$5,227,643	\$3,620,329.17	\$1,607,314	31%
Operating account interest		\$325,460		

Table 2 Summary of project expenditure against element, stage one

Element	NCB budget Nov 12 revised submission	NCB expenditure Feb 12-Feb 19	In-kind budget Nov 12 revised submission	In-kind expenditure Feb 12-Feb 19
Management and coordination Reporting and auditing	\$4,067,965	\$4,156,502	\$1,643,306	\$1,321,438
Impact assessment	\$150,000	\$59,641	\$85,000	
Sheep and goat eradication	\$1,205,000	\$465,664	\$120,000	\$396,756
Cat eradication	\$5,315,265	\$4,878,431	\$1,974,337	\$1,487,643
Black rat surveys	\$68,450	\$42,721	\$10,000	\$5,421
Biosecurity	\$30,000	\$29,432		
Vegetation restoration	\$154,200 ^{*1}	\$151,757		
Fire Management	\$7,000	\$33,470		
Weed Management	\$300,000	\$152,875		
Fauna reconstruction	Not Funded ^{*1}	\$630,552		\$145,320
Community engagement	\$239,229 ^{*1}	\$474,423		
Operations Base Infrastructure	Not funded ^{*1}		\$1,395,000	\$263,750
Total	\$11,537,109	\$11,075,467	\$5,227,643	\$3,620,329

^{*1} Element to be implemented or completed in full when additional funding is made available.

4 Conclusion

The first stage of the project has achieved significant milestones allowing the completion of the project objectives and all outcomes as specified in the May 2013 project plan. Stage one activities have resulted in the successful eradication of sheep (June 2016), feral goats (November 2017) and feral cats (October 2018); the confirmed absence of black rats (March 2017); completion of the weed management action plan and commencement of management actions; completion of the biosecurity implementation plan and protocols and implementation of recommendations; recovery of vegetation cover; heightened community awareness of, and support for, the project and the island's biodiversity values; and published reports on the project as well as scientific findings. In addition, preparation works for stage two were implemented from project savings and Operating Account interest including the

monitoring of source mammal populations on Bernier and Dorre islands and a pilot hare-wallaby translocation trial.

All milestones scheduled for completion in stage one were achieved as specified in the May 2013 project plan, or as rescheduled in the annual reports. Appendix 2 provides summary information of milestone performance.

A total of \$15,021,257 was expended against the first stage of the project; including \$11,075,467 NCB funds, \$3,620,329 in kind funds and \$325,460 of interest accrued in the Operating Account. A total of \$467,374 of the NCB budget has been carried into stage two with \$348,508 designated for the completion of the Herald Bay airstrip construction contract in winter 2019 and \$113,134 for project contingency.

Based on the success of stage one, in particular the progress on cat eradication, the Minister for Environment approved funding for the second stage of the project on 9 October 2016, with \$22,565,553 allocated over 13 years (2017-18 to 2029-30). A project plan for stage two was developed and approved by the Account Administrator in early 2017 (Parks and Wildlife 2017). The first translocation of animals under stage two of the project commenced in September 2018, as supported by the Advisory Board.

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Appendix 1 Stage one NCB budget taking into account the budget variance

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	Total
Total NCB Budget (Nov 2012 resubmission)	\$1,515,438	\$1,906,564	\$1,550,897	\$1,785,844	\$1,628,548	\$1,589,627	\$1,560,191	\$0	\$11,537,109
Sheep and Goat Eradication; implement the sheep and goat eradication plan as outlined in the Nov 2012 revised submission.		-\$245,000	\$245,000						
Impact Assessment; employ botanist during the establishment of the cat monitoring tracks and barrier fence as outlined in the Nov 2012 revised submission (reallocation of 2011-12 variance).			\$50,000						
Weed Management; complete weed control/eradication and monitoring works identified in the weed management plan as outlined in the Nov 2012 revised submission (reallocation of 2011-12 variance).			\$30,000	\$15,000	\$15,000	\$15,000	\$15,000		
2011-12 variance carried over into 2012-13 to meet rescheduled milestones as detailed in the 2012-13 annual report.		\$1,127,285							
Fauna Reconstruction; implement Group B activity 'Undertake monitoring of extant threatened fauna on DHI' (reallocation of 2012-13 variance).			\$21,300	\$22,000	\$22,660	\$23,360	\$24,000		
2012-13 variance carried over into 2013-14 to meet rescheduled milestones as detailed in the 2012-13 annual report.			\$1,322,313						
Sheep and Goat Eradication; reallocation of the element's budget surplus to fund a detector dog contract to detect the presence and location of goats and/or further independently verify the absence of goats (reallocation of 2013-14 variance).						\$70,000	\$130,000		
The dog detection (goat) contract was cancelled in Dec 2015 as the contract was deemed unnecessary considering the success of the goat program and the effectiveness of the established monitoring techniques as outlined in the half yearly update (31 Dec 2015).						-\$70,000	-\$130,000		
Fauna Reconstruction; reallocation of the dog detector (goat) contract budget surplus to partially fund the Stage 1 Group B activity 'monitor source populations of founder animals' in 2016-17.						\$120,000			
Project contingency, reallocation of the detector dog (goat) contract budget surplus to project contingency.					\$80,000				
Management and Coordination; employ a local Aboriginal trainee as a crew member and to assist with on ground project work (reallocation of 2013-14 variance).				\$38,737	\$71,240	\$75,172	\$77,427		

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	Total
Community Engagement; fund the continuation of the element from 2015-16 to 2017-18 (reallocation of 2013-14 variance).					\$87,960	\$92,865	\$92,045		
2013-14 variance carried over into 2014/15 to meet rescheduled milestones as detailed in the 2013/14 annual report.				\$413,140					
2014-15 variance carried over into 2015-16 to meet rescheduled milestones as detailed in the 2014-15 annual report.					\$342,743				
2015-16 variance carried over into 2016-17 to meet rescheduled milestones as detailed in the 2015-16 annual report.						\$522,942			
Cat Eradication; fund two additional island-wide seasonal surveillance programs in 2018-19, (winter and spring 2018), to confidentially confirm eradication (reallocation of 2016-17 variance).								182,322	
2016-17 variance carried over into 2017-18 to meet rescheduled milestones as detailed in the 2016-17 annual report.							\$388,604		
2017-18 variance carried over into 2018-19 to meet rescheduled milestones as detailed in the 2017-18 annual report.								\$303,978	
Total NCB budget, <i>including variance reallocated over 2011-12 to 2017-18</i> , as detailed in previous annual reports.		\$2,788,849	\$3,219,510	\$2,274,721	\$2,248,151	\$2,438,966	\$2,157,267	\$486,300	
Total NCB Expenditure for stage one	\$248,153	\$1,353,216	\$2,070,924	\$1,931,978	\$1,725,209	\$1,868,040	\$1,504,781	\$373,166	\$11,075,467.47
Variance	\$1,267,285	\$1,435,633	\$1,148,586	\$342,743	\$522,942	\$570,926	\$652,486	\$113,134	
NCB budget carried into stage two; reallocation of contingency for partial funding of an airstrip near Herald Bay. Construction may span the financial years 2018-19 and 2019-20.								\$348,508	\$348,508
NCB budget reallocated to stage two; stage one project contingency									\$113,133.53
Total NCB budget including the budget carried into stage two									\$11,537,109

Appendix 2 Milestone summary

Year	Milestones	Committed completion date	Date milestone achieved
1	<ol style="list-style-type: none"> 1. Completion of the 2011-2012 annual introduced black rat survey to confirm presence or absence on the island (Outcome & Output 2). 2. Appointment of a project manager (Outcome & Output 4). 3. Commence preparation of a revised project proposal including a detailed work plan (refer section 9) that identifies milestones, budgets and outputs (Outcome & Output 1). 4. Formation and meeting of a Management Committee for project implementation (Outcome & Output 1). 5. Appointment of a project officer in the Shark Bay District and a part time project officer (Outcome & Output 4). 6. Submission of the 2011-2012 annual report to DEC's Director General, for prompt transmission to the NCB Advisory Board (refer section 11) (Outcome & Output 6). 	<p>31 August 2011</p> <p>15 February 2012</p> <p>30 June 2012</p> <p>30 June 2012</p> <p>30 June 2012</p> <p>31 August 2012</p>	<p>August 2011</p> <p>February 2012</p> <p>August 2012</p> <p>March 2012</p> <p>June 2012</p> <p>September 2012</p>
2	<ol style="list-style-type: none"> 1. Completion of the fire management plan (Outcome & Output 2). 2. Completion of a weed management plan to direct control of high priority species (Outcome & Output 2). 3. Finalise the revised project proposal for submission to the NCB Advisory Board (Outcome & Output 1). 4. Completion of the consultant's draft biosecurity plan (Outcome & Output 2). 5. Preparation of a Detailed Work Plan for 2012-2013 to be approved by DEC's Director Nature Conservation (section 9) (Outcome & Output 1). 6. Completion of the community engagement strategy (Outcome & Output 3). 7. Completion of community engagement displays and publications (Outcome & Output 3). 8. Completion of biosecurity protocols for use by DEC (Outcome & Output 2). 9. Finalise initial meetings to inform the community about the project and biosecurity measures (Outcome & Output 3). 10. Completion of planning to establish temporary accommodation at Herald Bay and Sandy point and construction of southern camp at Herald Bay (Outcome & Output 5). 11. Planning and environmental approvals obtained for 'Group A' elements (Outcome & Output 1). 12. Completion of Aboriginal heritage agreement (Outcome & Output 1). 13. Acquisition and operational deployment of the project barge (Outcome & Output 1). 	<p>31 August 2012</p> <p>30 November 2012</p> <p>30 November 2012</p> <p>30 November 2012</p> <p>30 November 2012</p> <p>31 December 2012</p> <p>31 December 2012</p> <p>28 February 2013</p> <p>31 January 2013</p> <p>30 June 2013</p> <p>30 June 2013</p> <p>30 June 2013</p> <p>30 June 2013</p>	<p>August 2012</p> <p>November 2012</p> <p>November 2012</p> <p>August 2012</p> <p>September 2012</p> <p>April 2013</p> <p>May 2013</p> <p>April 2013</p> <p>June 2013</p> <p>April 2014</p> <p>March 2013</p> <p>March 2013</p> <p>May 2014</p>

Year	Milestones	Committed completion date	Date milestone achieved
	<p>14. Installation of a barge mooring at Denham (Outcome & Output 1).</p> <p>15. Finalisation of cat fence alignment (Outcome & Output 2).</p> <p>16. Completion of a black rat survey (Outcome & Output 2).</p> <p>17. Acquisition of remote sensing monitoring for vegetation restoration (Outcome & Output 2).</p> <p>18. Finalisation and distribution of initial project information to neighbours (Outcome & Output 4).</p> <p>19. Presentation of three quarterly updates to DEC's Director General, for prompt transmission to the NCB Advisory Board (section 11) (Outcome & Output 6).</p> <p>20. Submission of the 2012-2013 annual report to DEC's Director General, for prompt transmission to the NCB Advisory Board (Outcome & Output 6).</p>	<p>30 June 2013</p> <p>30 June 2013</p> <p>30 June 2013</p> <p>30 June 2013</p> <p>30 June 2013</p> <p>31 October 2012 31 January 2013 30 April 2013</p> <p>31 August 2013</p>	<p>June 2013</p> <p>December 2012</p> <p>May 2013</p> <p>June 2013</p> <p>January-May 2013</p> <p>October 2012 March 2013 May 2013</p> <p>August 2013</p>
3	<p>1. Preparation of a Detailed Work Plan for 2013-2014 to be approved by DEC's Director Nature Conservation (section 9) (Outcome & Output 1).</p> <p>2. Identification of volunteering opportunities (Outcome & Output 3).</p> <p>3. Finalise initial consultation meetings with neighbours regarding planning and developing biosecurity measures (Outcome & Output 3).</p> <p>4. Acquisition of a jinker (Outcome & Output 1).</p> <p>5. Installation of three barge moorings at DHI (Outcome & Output 1).</p> <p>6. Construction of cat fence completed (Outcome & Output 2).</p> <p>7. Confirmation of eradication of sheep from the island (Outcome & Output 2).</p> <p>8. Completion of first cat baiting operation (Outcome & Output 2).</p> <p>9. Complete construction of temporary accommodation at northern campsite for the cat eradication team (Outcome & Output 5).</p> <p>10. Completion of a black rat survey (Outcome & Output 2).</p> <p>11. Completion of the biosecurity implementation plan (Outcome & Output 2).</p> <p>12. Acquisition of remote sensing monitoring for vegetation restoration (Outcome & Output 2).</p> <p>13. Complete annual weed control/eradication works and monitor Weed Surveillance Areas for 'new to island' weed species (Outcome & Output 2).</p> <p>14. Appointment of three new staff to the cat eradication program (Outcome & Output 4).</p> <p>15. Presentation of three quarterly updates to DEC's Director General, for prompt transmission to the NCB Advisory Board (section 11) (Outcome & Output 6).</p>	<p>30 June 2013</p> <p>31 December 2013</p> <p>31 January 2014</p> <p>30 June 2014</p> <p>31 December 2013</p> <p>31 March 2014</p> <p>30 June 2014</p> <p>30 June 2014</p> <p>30 June 2014</p> <p>30 June 2014</p> <p>30 June 2014</p> <p>30 June 2014</p> <p>30 June 2014</p> <p>30 June 2014</p> <p>31 October 2013 31 January 2014 30 April 2014</p>	<p>June 2013</p> <p>December 2013</p> <p>May 2014</p> <p>September 2013</p> <p>August 2014</p> <p>September 2014</p> <p>June 2016</p> <p>May 2014</p> <p>December 2015</p> <p>May 2014</p> <p>June 2014</p> <p>March 2014</p> <p>June 2015</p> <p>March 2014</p> <p>October 2013 January 2014 April 2014</p>

Year	Milestones	Committed completion date	Date milestone achieved
	<p>16. Submission of the 2013-2014 annual report to DEC's Director General, for prompt transmission to the NCB Advisory Board (Outcome & Output 6).</p> <p>Additional milestones (Group B):</p> <p>1. Commence genetic material collection from the extant threatened fauna on DHI to determine the level of divergence from the mainland counterparts (Group B, Activity 2).</p> <p>2. Completion of the extant threatened fauna (three bird and one reptile species) monitoring surveys, and report (Group B, Activity 2).</p>	<p>31 August 2014</p> <p>31 October 2013</p> <p>30 June 2014</p>	<p>August 2014</p> <p>August 2013</p> <p>June 2014</p>
4	<p>1. Preparation of a Detailed Work Plan for 2014-2015 to be approved by DEC's Director Nature Conservation (section 9) (Outcome & Output 1).</p> <p>2. Completion of a black rat survey (Outcome & Output 2).</p> <p>3. Acquisition of remote sensing monitoring for vegetation restoration (Outcome & Output 2).</p> <p>4. Complete annual weed control/eradication works and monitor Weed Surveillance Areas for 'new to island' weed species (Outcome & Output 2).</p> <p>5. Review community engagement strategy (Outcome & Output 3)</p> <p>6. Presentation of three quarterly updates to DEC's Director General, for prompt transmission to the NCB Advisory Board (section 11) (Outcome & Output 6).</p> <p>7. Submission of the 2014-2015 annual report to DEC's Director General, for prompt transmission to the NCB Advisory Board (Outcome & Output 6).</p> <p>Additional milestones:</p> <p>1. Completion of the extant threatened fauna (three bird and one reptile species) monitoring surveys, and report (Group B, Activity 2).</p> <p>2. Completion of the report on the level of genetic divergence of extant threatened fauna from mainland counterparts (Group B, Activity 2).</p>	<p>30 June 2014</p> <p>30 June 2015</p> <p>30 June 2015</p> <p>30 June 2015</p> <p>30 June 2015</p> <p>31 October 2014 31 January 2015 30 April 2015</p> <p>31 August 2015</p> <p>30 June 2015</p> <p>30 June 2015</p>	<p>June 2014</p> <p>Cancelled, not required.</p> <p>June 2015</p> <p>June 2015</p> <p>June 2105</p> <p>October 2014 January 2015 April 2015</p> <p>August 2015</p> <p>March 2016</p> <p>June 2018</p>
5	<p>1. Preparation of a Detailed Work Plan for 2015-2016 to be approved by DEC's Director Nature Conservation (section 9) (Outcome & Output 1).</p> <p>2. Completion of on-ground cat eradication works (Outcome & Output 2)</p> <p>3. Completion of a black rat survey (Outcome & Output 2).</p> <p>4. Acquisition of remote sensing monitoring for vegetation restoration (Outcome & Output 2).</p> <p>5. Completion of annual weed control/eradication works and monitoring of Weed Surveillance Areas for 'new to island' weed species (Outcome & Output 2).</p>	<p>30 June 2015</p> <p>30 June 2016</p> <p>30 June 2016</p> <p>30 June 2016</p> <p>30 June 2016</p>	<p>June 2015</p> <p>June 2016</p> <p>September 2016</p> <p>March 2016</p> <p>June 2016</p>

Year	Milestones	Committed completion date	Date milestone achieved
	<p>6. Presentation of a half yearly update to the Director General, for prompt transmission to the NCB Advisory Board. (section 11, revised Sep 2015) (Outcome & Output 6).</p> <p>7. Submission of the 2015-2016 annual report to DEC's Director General, for prompt transmission to the NCB Advisory Board (Outcome & Output 6).</p> <p>Additional milestones:</p> <p>1. Completion and analysis of 30 years of threatened mammal abundance data on Bernier and Dorre islands to determine population abundance and factors that may affect population fluctuations of potential founder animals (Group B, Activity 2).</p> <p>2. Completion of the extant threatened fauna (three bird and one reptile species) monitoring surveys and report (Group B, Activity 2).</p> <p>3. Completion of at least one community celebration event (Unfunded Group A, Outcome and Output 3).</p> <p>4. Completion of at least four local community information updates to gain or maintain community understanding and support for the project (Unfunded Group A, Outcome and Output 3).</p>	<p>31 January 2016</p> <p>31 August 2016</p> <p>31 December 2015</p> <p>30 June 2016</p> <p>30 June 2016</p> <p>30 June 2016</p>	<p>February 2016</p> <p>August 2016</p> <p>December 2015</p> <p>September 2016</p> <p>June 2016</p> <p>30 June 2016</p>
6	<p>1. Preparation of a Detailed Work Plan for 2016-2017 to be approved by DEC's Director Nature Conservation. (section 9) (Outcome & Output 1).</p> <p>2. Completion of a black rat survey (Outcome & Output 2).</p> <p>3. Acquisition of remote sensing monitoring for vegetation restoration (Outcome & Output 2).</p> <p>4. Completion of annual weed control/eradication works and monitoring of Weed Surveillance Areas for 'new to island' weed species (Outcome & Output 2).</p> <p>5. Presentation of a half yearly update to the Director General, for prompt transmission to the NCB Advisory Board. (section 11, revised Sep 2015) (Outcome & Output 6).</p> <p>6. Submission of the 2016-2017 annual report to DEC's Director General, for prompt transmission to the NCB Advisory Board (Outcome & Output 6).</p> <p>Additional milestones:</p> <p>1. Completion of the extant threatened avifauna monitoring survey, and report (Group B, Activity 2).</p> <p>2. Completion of at least one community celebration event (Unfunded Group A, Outcome and Output 3).</p> <p>3. Completion of at least four local community information updates to gain or maintain community understanding and support for the project (Unfunded Group A, Outcome and Output 3).</p>	<p>30 June 2016</p> <p>30 June 2017</p> <p>30 June 2017</p> <p>30 June 2017</p> <p>31 January 2017</p> <p>31 August 2017</p> <p>30 June 2017</p> <p>30 June 2017</p> <p>30 June 2017</p>	<p>June 2016</p> <p>Cancelled, not required.</p> <p>February 2017</p> <p>June 2017</p> <p>January 2017</p> <p>August 2017</p> <p>July 2017</p> <p>August 2016</p> <p>30 June 2017</p>

Year	Milestones	Committed completion date	Date milestone achieved
7	1. Preparation of a Detailed Work Plan for 2017-2018 to be approved by DEC's Director Nature Conservation (section 9) (Outcome & Output 1).	30 June 2017	June 2017
	2. Provide submission to the NCB Advisory Board for stage two of the project (Outcome & Output 2)	30 September 2017	October 2016
	3. Confirmation of goat eradication (Outcome & Output 2).	30 June 2018	November 2017
	4. Confirmation of cat eradication (Outcome & Output 2).	30 June 2018	October 2018
	5. Completion of a black rat survey (Outcome & Output 2).	30 June 2018	Cancelled, not required.
	6. Acquisition of remote sensing monitoring for vegetation restoration (Outcome & Output 2).	30 June 2018	June 2018
	7. Completion of annual weed control/eradication works and monitoring of Weed Surveillance Areas for 'new to island' weed species (Outcome & Output 2).	30 June 2018	June 2018
	8. Confirm eradication of five priority weed species (couch, castor oil, Japanese pepper, lupin and wild radish) (Outcome & Output 2). Milestone is not achievable due to the length of seed viability in the soil; modified to 'Confirm removal of known eradicate species, with removal of germinates from the seed bank until eradication can be confirmed'.	30 June 2018	June 2018
	9. Confirm containment of three priority weed species (ice plant, fourleaf allseed and false sowthistle) (Outcome & Output 2). Milestone is not achievable as fourleaf allseed has been removed a priority species due to its low ecological impact and low feasibility of control; modified to 'Confirm containment of known priority species'.	30 June 2018	June 2018
	10. Presentation of a half yearly update to the Director General, for prompt transmission to the NCB Advisory Board. (section 11, revised Sep 2015) (Outcome & Output 6).	31 January 2018	January 2018
	11. Submission of the 2017-2018 annual report and the final report to DEC's Director General, for prompt transmission to the NCB Advisory Board (Outcome & Output 7).	31 August 2018	August 2018
	Additional milestones:		
	1. Completion of the extant threatened avifauna monitoring survey and final report (Group B, Activity 2).	30 June 2018	June 2018
	2. Undertake trial translocation of rufous and banded hare-wallabies to DHI and monitor outcomes.	31 October 2017 Monitor to 30 June 2018	August 2017 June 2018